

C400 52324595W
 SAMPLE DESCRIPTION OF FLORENCE 8-1 (oil shaft assessment hole)

RECEIVED
 OCT 22 1973

NOV 3 1973
 HAROLD E. CARRIER

- 0'-10' intbd. sltst. and ss., gy, v.f.g., mod. well sorted, calcareous;
- 10'-20' intbd. sltst. and ss., gy., v.f.g., mod. well sorted., occ. silty, calcareous, with scattered zones of limonite staining;
- 20'-30' intbd. sltst. and ss., gy. to brn., v.f.g., commonly silty, calcareous, zones of limonite staining common;
- 30'-40' intbd. sltst. and sh., lt. gy. to dk. gy., sh. is silty, darker gy. than sltst., calcareous;
- 40'-50' intbd. sltst. and sh., lt. gy. to dk. gy., sh. is silty, trace of carbonized plant material, calcareous;
- 50'-60' intbd. sltst. and sh., gy. to dk. gy., trace ss., lt. gy., silty, w/ scat. occurrences of pyrite, calcareous;
- 60'-70' intbd. sltst. and sh., gy. to dk. gy., scat. zns. of limonite staining, calcareous;
- 70'-80' intbd. sh. and sltst., lt. gy. to dk. gy., sltst. occasionally sandy, calcareous;
- 80'-90' intbd. sh. and sltst., gy. to dk. gy., sltst. is sandy, scat. traces of carbonized material, calcareous;
- 90'-100' sltst., gy., sandy, trace carbonized material, calcareous;
- 100'-110' sltst., gy., sandy, calcareous;
- 110'-120' sltst., gy., sandy, and intbd. ss., lt. gy. to gy., v.f.g., silty, w/ scattered zns. of limonite staining, calcareous;
- 120'-130' sltst., gy., sandy, and intbd. ss., gy., v.f.g., silty, calc.;
- 130'-140' sltst., gy., slightly sandy, and intbd. ss., ylw.-brn., v.f.g., silty, limonite staining common, slightly calcareous;
- 140'-150' ss., ylw.-brn., limonite staining v. common, v.f.g. to f.g., silty, calcareous, and intbd. siltstone, gy., v. slightly calcareous, fragments of carbonaceous material common in both ss. and sltst.;
- 150'-160' intbd. sltst., gy., sandy, and ss., gy., v.f.g. to f.g., silty, ss. is slightly calcareous;
- 160'-170' ss., gy. to light gy., v.f.g. to f.g., silty, scat. mica flakes, slightly calcareous, and intbd. sltst., gy., sandy, w/ scattered traces carbonaceous material in both ss. and sltst.;
- 170'-180' ss., gy., v.f.g. to f.g., silty, sl. calcareous, poorly sorted, w/ carbonaceous material scattered throughout;
- 180'-190' ss., gy., v.f.g. to f.g., silty, slightly calcareous, carbonaceous material scattered throughout;
- 190'-200' tuffaceous ss., lt. gy. to gy., v.f.g. to f.g., silty, slightly calcareous, limonite stained zones common;

- 200'-210' tuffaceous ss., gy., v.f.g. to f.g., silty, and interbedded sltst., gy., sandy, slightly calcareous;
- 210'-220' sltst., gy., sandy, calcareous, and intbd. ss., gy., v.f.g. to f.g., tuffaceous;
- 220'-230' intbd. ss. and sltst., gy., ss. is v.f.g. to f.g., silty, sltst. is occasionally sandy, scattered traces of carbonaceous material, slightly calcareous;
- 230'-240' ss., gy., v.f.g. to f.g., slight trace of pyrite, slightly calcareous, and occasional, intbd. marlstone, gy.;
- 240'-250' mrlst., gy., tr. carbonaceous material, and some intbd. ss., gy., v.f.g., silty;
- 250'-260' tuffaceous ss., gy., v.f.g., silty, v. slightly calcareous, and some interbedded marlstone, gy.;
- 260'-270' tuffaceous ss., lt. gy. to gy., v.f.g. to f.g., silty, and intbd. sltst., gy., sandy, slightly calcareous;
- 270'-280' as above
- 280'-290' ss., gy., v.f.g., silty, sl. calcareous, with scattered carbonaceous material;
- 290'-300' tuffaceous ss., gy., v.f.g. to f.g., silty, slightly calcareous, and intbd. sltst., gy., sandy;
- 300'-310' tuffaceous ss., gy. to lt. gy., v.f.g. to f.g., silty, trace of pyrite, and intbd. sltst., gy., sandy;
- 310'-320' as above
- 320'-330' intbd. ss. and sltst., lt. gy. to gy., ss. is v.f.g., silty, sl. calcareous, sltst. is sandy, calcareous;
- 330'-340' tuffaceous sltst., gy., sandy;
- 340'-350' ss., lt. gy. to gy., v.f.g., and intbd. mrlst., brown, "rusty"--limonite stained;
- 350'-360' tuffaceous ss., lt. gy., v.f.g., slightly calcareous;
- 360'-370' tuffaceous ss., lt. gy. to gy., v.f.g., silty, and intbd. sltst., gy., sandy;
- 370'-380' intbd. ss. and sltst., as above;
- 380'-390' tuffaceous ss., gy., v.f.g., silty, and intbd. mrlst., lt. gy.;
- 390'-400' tuffaceous ss., gy. to lt. gy., v.f.g., silty, and intbd. sltst., gy., sandy, and intbd. mrlst., lt. gy.;

400'-410' tuffaceous ss., lt. gy. to gy., v.f.g., silty, and intbd. sltst., gy., slightly calcareous;

410'-420' ss., as above

420'-430' tuffaceous ss., gy., v.f.g. to f.g., silty, slightly calcareous;

430'-440' ss., as above, and intbd. mrlst., lt. gy.;

440'-450' ss., w/ intbd. mrlst., as above;

450'-460' tuffaceous ss., gy., v.f.g. to f.g., silty, calcareous;

460'-470' tuffaceous ss., gy., v.f.g., silty, and intbd. mrlst., reddish-brn.;

470'-480' as above

480'-490' tuffaceous ss., gy., v.f.g., silty, slightly calcareous;

490'-500' tuffaceous ss., gy., v.f.g., silty, and intbd. mrlst., reddish-brn., occ. black;

500'-510' mrlst., reddish-brn. to gy., trace carbonaceous material, and some intbd. sandy, siltstone, lt. gy. to gy., calcareous, tuffaceous;

510'-520' as above, w/ sandy sltst. more common;

520'-530' as above

530'-540' tuffaceous sandstone, gy. to lt. gy., v.f.g., silty, calcareous, tr. pyrite, and intbd. mrlst., gy. to lt. brn.;

540'-550' intbd. ss. and mrlst., as above;

550'-560' as above

560'-570' tuffaceous ss., lt. gy. to gy., v.f.g., silty, calcareous, and interbedded mrlst., gy. to pale reddish-brown (possibly some lt. gy. tuff);

570'-580' as above

580'-590' intbd. ss. and mrlst., as above

590'-600' mrlst., gy. to blk.-brn., and some intbd. ss., lt. gy., v.f.g., silty, calcareous;

600'-610' tuffaceous ss., lt. gy. to gy., v.f.g., silty, calcareous, and intbd. mrlst., gy. to tannish-gy.;

610'-620' intbd. ss. and mrlst., as above;

620'-630' tuffaceous ss., lt. gy., v.f.g., silty, calcareous, w/ trace of tannish mrlst.;

630'-640' tuffaceous ss., lt. gy., v.f.g., tr. mtx. pyrite, calcareous, and intbd. mrlst., tan to reddish-brown;

640'-650' mrlst., as above, with some intbd. ss., as above;

650'-660' mrlst., lt. gy. to brn.-blk., w/ sl. tr. ss.; as above;

660'-670' as above

670'-680' intbd. mrlst. and ss., as above;

680'-690' mrlst., dk. gy. to brn.-blk., w/ some intbd. tuffaceous ss., lt. gy., v.f.g., calcareous;

690'-700' mrlst., gy.-tn. to blk.;

700'-710' as above

710'-720' mrlst., brn.-tn. to blk.;

720'-730' as above

730'-740' mrlst., as above, commonly with very fine banding of brn.-tn. and blk. colored layers;

740'-750' as above, w/ tr. white material along bedding plane (analcite?);

750'-760' mrlst., gy.-brn. to blk.;

760'-770' as above

770'-780' as above

780'-790' mrlst., brn.-gy., occasionally brn.-blk. to blk.;

790'-800' mrlst., brownish-gray to gray, trace of black;

800'-810' mrlst., brn.-gy. to blk.;

810'-820' mrlst., gy. to brn.-gy., occasionally blk., tr. marcasite;

820'-830' mrlst., as above;

830'-840' mrlst., gy. to brn.-gy.;

840'-850' mrlst., brn.-gy.;

850'-860' mrlst., brn.-gy., to brn.-blk., and tr. tuffaceous ss., lt. gy. to gy., v.f.g., silty, slightly calcareous; fractured zone encountered @ 865', making water @ 30-50 gpm (driller's estimate); brecciation, limonite coating, calcite coatings, and solution features observed in cuttings; lithology is calcareous, tuffaceous siltstone, gray, and gray marlstone;

CONT DESCRIPTION OF FLORENCE 8-1 (1 shale assessment hole)

968'-971' marlstone, black to dark gray, occasionally light gray, fine-banded; @ 969'5" is 3/8" thick analcitized tuff bed; @ 970'3 1/2" is a pinkish tuff bed, approx. 3/8" to 1/2" thick;

971'-972'7" marlstone, dark gray to brownish black, fine-banded;

972'7"-
972'8" 1" thick gray shale;

972'8"-
979'7" marlstone, gray to dark gray, fine-banded;

979'5"-
979'7" interbedded marlstone, light gray, fine-banded, with some contortion in banding, and light gray to white tuff;

979'7"-
980' light gray to white, analcitized tuff (Mahogany Marker);

980'4"-
986'4" marlstone, dark gray to brownish black, fine-banded; @ 981'10" is small, vertical fracture; @ 985'2" is thin tuff zone;

986'4" small cavity, lined with nacholite (?)

986'6"-
991' marlstone, gray to brownish black, fine-banded;

991'-
993'5" marlstone, gray to brownish black, fine-banded, with scattered, white bands, 1/8" to 1/2" thick, and fractured areas; near-vertical fracture from 991' to 991'5"; near-vertical to slightly inclined fracture from 991'10" to 992'5"; fracture @ 45° from 993'3" to 993'5"; a 3" zone filled with asphaltic material and contorted banding from 992'6" to 992'9";

993'5"-
999'5" marlstone, brownish black to black, fine-banded;

999'5"-
1001' missing core

1001'-
1017' marlstone, brownish black to blue black, generally fine-banded; 6" vertical fracture from 1001' to 1001'6"; @ 1002'7" is 2" fracture zone with fracture @ 45°; @ 1005'7" to 1006'2" is fracture with approx. a 60° dip; @ 1011'11" is thin, black shale zone; @ 1016'2" is zone 2 1/2" thick with nacholite cavities; from 1016'6" to 1016'10" is a black shale zone;

1017'-
1034'4" marlstone, grayish brown to dark gray, fine-banded, with 1/4" tuff bed @ 1023'7"; from 1028'8" to 1028'10" is zone

of asphaltic residue and contorted bedding; some solution appears to have occurred in this zone; @ 1032'4" is 1"-2" zone with small, crystal filled cavities;

1035'-
1044'6"

marlstone, light gray to dark gray, fine-banded, from 1036'8" to 1037'4" is light gray, shaley, marlstone; 1044'2" to 1044'6" is contorted zone with areas of black, pyritic material; @ 1047'2" is a 2" zone with trace of material like that from 1044'2" to 1044'6"; from 1049' to 1050' is solution cavity filled with honey-combed material (nacholite cavity?);

1050'-
1054'2"

marlstone, brownish black to black, fine-banded; @ 1052'6" is 1" thick zone of contorted bedding; from 1054'2" to 1055'2" is zone of contorted and disturbed bedding in light gray to gray marlstone; there is a 3" gray tuff bed from 1055'2" to 1055'5";

1055'5"-
1061'2"

marlstone, gray black to gray, fine-banded, contorted banding in lower 6" of section;

1061'2"-
1061'4"

2 inch zone of black, calcareous shale;

1061'4"-
1064'4"

marlstone, gray to dark gray, fine-banded;

1064'4"-
1072'

no core recovered;

1072'-
1082'

marlstone, gray to brownish black, fine-banded, with 6" zone of disturbed bedding from 1074' to 1074'6";

1082'-
1084'

marlstone, very light gray to grayish black, fine-banded; from 1083'4" to 1084' (8" thick zone) is disurbed zone; 1" thick, analcitized tuff zone @ 1083'5"; lower 8" zone contains numerous, small solution cavities;

MEMORANDUM REPORT

RESULTS OF TESTING DRILL-HOLE FLORENCE 8-1 AND RECOMMENDATIONS FOR FURTHER DRILLING

INTRODUCTION

The purpose of this report is to discuss the results of testing obtained from exploration well Florence 8-1 drilled on Union Oil Company lands in the Piceance Basin, northwestern Colorado, near the center of Section 32, T. 4 S., R. 95 W. In addition, recommendations are given for additional exploratory well-drilling based on these test results and observations on the hydrogeology of the area made by the writer during July and August of 1973.

Florence 8-1 was drilled to a total depth of 1,102 feet from a land surface elevation of approximately 8142.3 feet above sea level. The upper 880 feet of the borehole is cased with 5½-inch welded steel casing, and the lower 222 feet is 4 3/4-inch open hole. The borehole was drilled in the lower part of the Evacuation Creek and upper part of the Parachute Creek members of the Tertiary Green River Formation. The borehole was capped with a rubber well-seal for ease of re-entry. The static water level in the hole was 7,647 feet above sea level, measured on July 30, 1973.

PUMP TEST PROCEDURE AND ANALYSIS

The pump test of Florence 8-1 began at 1:48 p.m. and terminated at 5:01 p.m. on July 30, 1973 for a total duration of 193 minutes. A 600 cubic feet per minute compressor was used to introduce air through the drill pipe at a depth of 620 feet in the borehole. Water was air-lifted out of the borehole at a rate varying from 9 to 28 gpm (gallons per minute). Discharge measurements were obtained with a 5 gallon drum and watch. The average discharge rate for the test was 23.5 gpm.

It is not tenable to obtain meaningful water level draw-down measurements during this type of test. Approximately three hours after the test began, a water sample was collected for chemical analysis. The air compressor was turned off after an elapsed time of 193 minutes, at 5:01 p.m.; seven minutes elapsed while the compressor was disconnected from the drill pipe, and the electric sounder was installed in the borehole. The first water level measurement, obtained at 5:08 p.m., was 499.8 feet below land surface, for a drawdown of 4.05 feet. Maximum drawdown in the borehole during the test was probably two or three times this much.

Water level recovery data from Florence 8-1 was analyzed by plotting on a semilogarithmic graph the residual drawdown, which is the magnitude of drawdown remaining at any time after pumping stopped (t'), versus the ratio of t/t' , where t is the elapsed time since pumping started (Figure 1). A straight line was fitted to the data points, and the slope of the straight line was used to compute the transmissivity of the formation.

12 DIVISIONS PER INCH ON SHORT SIDE
2 5-INCH CIRCLES ON LONG SIDE

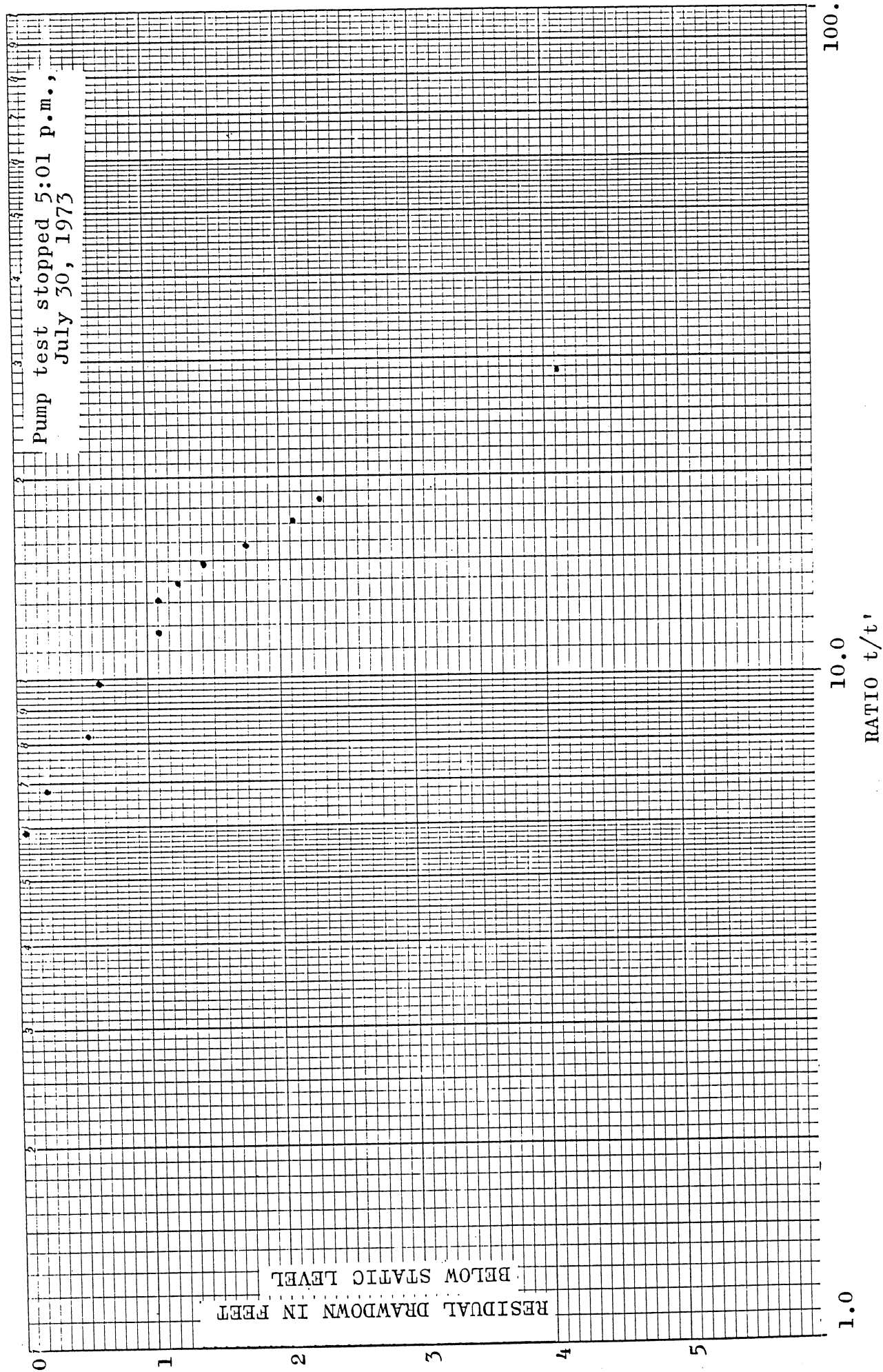


FIGURE 1 : WATER LEVEL RECOVERY IN DRILL-HOLE

FLORENCE 8-1, JULY 30, 1973.

Analysis of the recovery data for Florence 8-1 indicates a transmissivity of approximately 1,000 gpd/ft (gallons per day per foot). The water level recovered to the static level 40 minutes after the air compressor was turned off.

Mud circulation was lost while drilling the borehole at a depth of approximately 860 feet, in what is apparently a fracture zone. The casing was set at 880 feet and drilling continued, but circulation was never restored. This indicates that the zones below 860 feet may have the greatest permeability.

HYDROGEOLOGY

Several springs issue from joints in platy marlstone in the canyon floor of the upper reach of the Middle Fork of Parachute Creek, approximately 3,000 feet west of the ridge-top site of Florence 8-1. The springs issue from almost horizontal platy marlstone beds of the Evacuation Creek member, broken by numerous parallel joints striking N. 60° W. and dipping generally 85° SW. The discharge of the springs on August 8, 1973, was estimated to be 30 gpm. The springs discharge at an elevation of approximately 7,650 feet, which is in approximate agreement with the static water level in Florence 8-1.

The total dissolved solids content of the spring discharge, as indicated by electrical conductivity measurements, is approximately 520 ppm (parts per million) which is similar to groundwater pumped from Florence 8-1.

These springs probably represent discharge from the same fracture system penetrated by the Florence 8-1 borehole in the lower portions of the Evacuation Creek member.

CHEMICAL QUALITY OF WATER

Chemical analysis of the water sample collected from Florence 8-1 reveals that the groundwater is a sodium-bicarbonate water with significant amounts of sulfate (Table 1). In general, the chemical quality of the water is good, with a total dissolved solids content of approximately 580 ppm (parts per million). The total hardness of the water is relatively high (202 ppm) for most industrial uses.

CONCLUSIONS

Limited pump test data indicate that the upper 200 feet of the Parachute Creek member and the lower 100 feet of the Evacuation Creek member contain groundwater of good quality in fractures. The transmissivity of this zone, based on limited test data, is approximately 1,000 gpd/ft. Properly constructed wells tapping this zone might yield 100 gpm or more.

TABLE 1 --- CHEMICAL ANALYSIS OF GROUNDWATER
FROM FLORENCE 8-1, JULY 30, 1973

<u>CONSTITUENT</u>	<u>CONCENTRATION</u> <u>(PARTS PER MILLION)</u>
Calcium	49
Magnesium	19.0
Sodium	134
Carbonate	0
Bicarbonate	372.7
Chloride	less than 4.0
Sulphate	185
Nitrate (N)	less than 0.1
Boron	0.16
Fluoride	1.37
Silica	24.0
Total Hardness as CaCO_3	201.5
Total dissolved solids	579
Specific conductance (micromhos)	1050
Temperature ($^{\circ}\text{F}$)	56
pH	7.7

Analysis by BC Laboratories, Bakersfield, California

RECOMMENDATIONS

- (1) The most favorable sites for additional drilling for water exploration are in the upper reaches of the Middle Fork of Parachute Creek in the eastern one-half of Section 31, T. 4 S., R. 95 W., in the vicinity of the original Florence drill-hole. Holes should be drilled in the canyon floors, and not on the ridges.
- (2) A minimum borehole diameter of 6-inches is recommended, but an 8-inch diameter is preferred to accommodate testing in multiple zones of the rock sequence, for water sampling purposes, and air-lift pump-testing.
- (3) The exploratory holes should be drilled to the base of the Parachute Creek member, with borehole depths of approximately 1,200 to 1,500 feet, in order to test the water potential in the "leached" zone below the Mahogany zone.
- (4) In order to determine the potential water-bearing zones and their approximate relative permeabilities, several borehole geophysical logs should be conducted, particularly electrical resistivity, temperature, and gamma gamma neutron.

Union

Modified Fischer ~~1972~~ 1976

depth in ft

Farrison's Cores

Florence 8-1

SAMPLE NO.	Oil wt %	Oil Gr/Ton
968-969	14.7	38.8
969-970	14.6	49.3
970-971	16.1	43.5
971-972	10.1	26.7
972-973	8.5	22.6
973-974	7.0	28.3
974-975	6.1	15.9
975-976	11.3	29.5
976-977	8.0	21.1
977-978	6.0	15.7
978-979	6.0	15.7
979-980	4.2	10.8
980-981	2.4	6.2
981-982	11.3	30.1
982-983	5.0	13.0
983-984	5.2	13.6
984-985	5.0	13.3
985-986	11.4	30.8
986-987	10.5	27.7
987-988	12.7	33.5
988-989	22.2	58.9
989-990	16.5	43.5
990-991	21.5	56.7
991-992	25.3	66.2
992-993	25.9	67.8
993-994	22.2	58.6
994-995	19.0	50.1
995-996	17.3	45.6
996-997	17.8	46.6
997-998	13.4	35.0
998-999	11.4	29.6
999-1000	9.9	25.7

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Union

[illegible]

SAMPLE No	WT TO	Oil	GHT
037	1038	57	149
038	1039	7.6	20.0
039	1040	8.2	21.5
040	1041	69	180
041	1042	88	231
042	1043	100	262
043	1044	113	299
044	1045	114	302
045	1046	111	296
046	1047	150	399
047	1048	16.5	43.8
048	1049	149	394
049	1050	140	379
050	1051	136	356
051	1052	missing	
052	1053	7.2	19.0
053	1054	10.4	28.2
054	1055	76	207
055	1056	27	70
056	1057	27	72
057	1058	52	138
058	1059	104	270
059	1060	74	193
060	1061	6.8	17.8
061	1062	13.0	34.5
062	1063	134	356
063	1064	83	220
064	1065	7.1	18.6
065	1066	missing	
066	1067		
067	1068		
068	1069		
069	1070		

SAMPLE NO	OIL WT %	OIL G/T
C70 - 1071	11.4	30.7
C71 - 1072	13.1	34.8
C72 - 1073	10.4	27.3
C73 - 1074	8.4	22.0
C74 - 1075	11.9	32.0
C75 - 1076	12.1	31.9
C76 - 1077	9.2	19.0
C77 - 1078	5.6	14.7
C78 - 1079	6.7	17.7
C79 - 1080	6.8	17.9
C80 - 1081	6.1	16.1
C81 - 1082	4.6	12.0
C82 - 1083		
C83 - 1084		